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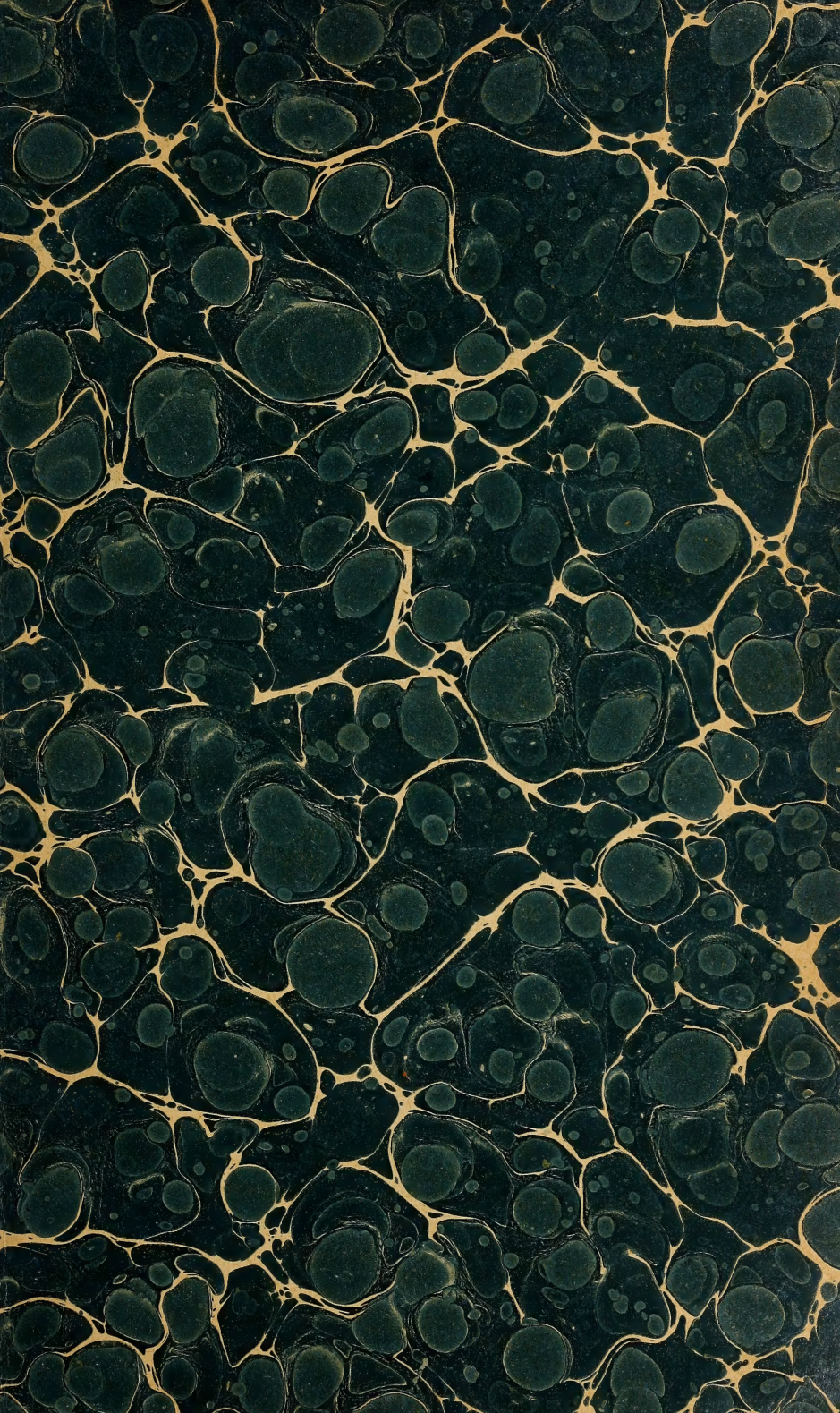
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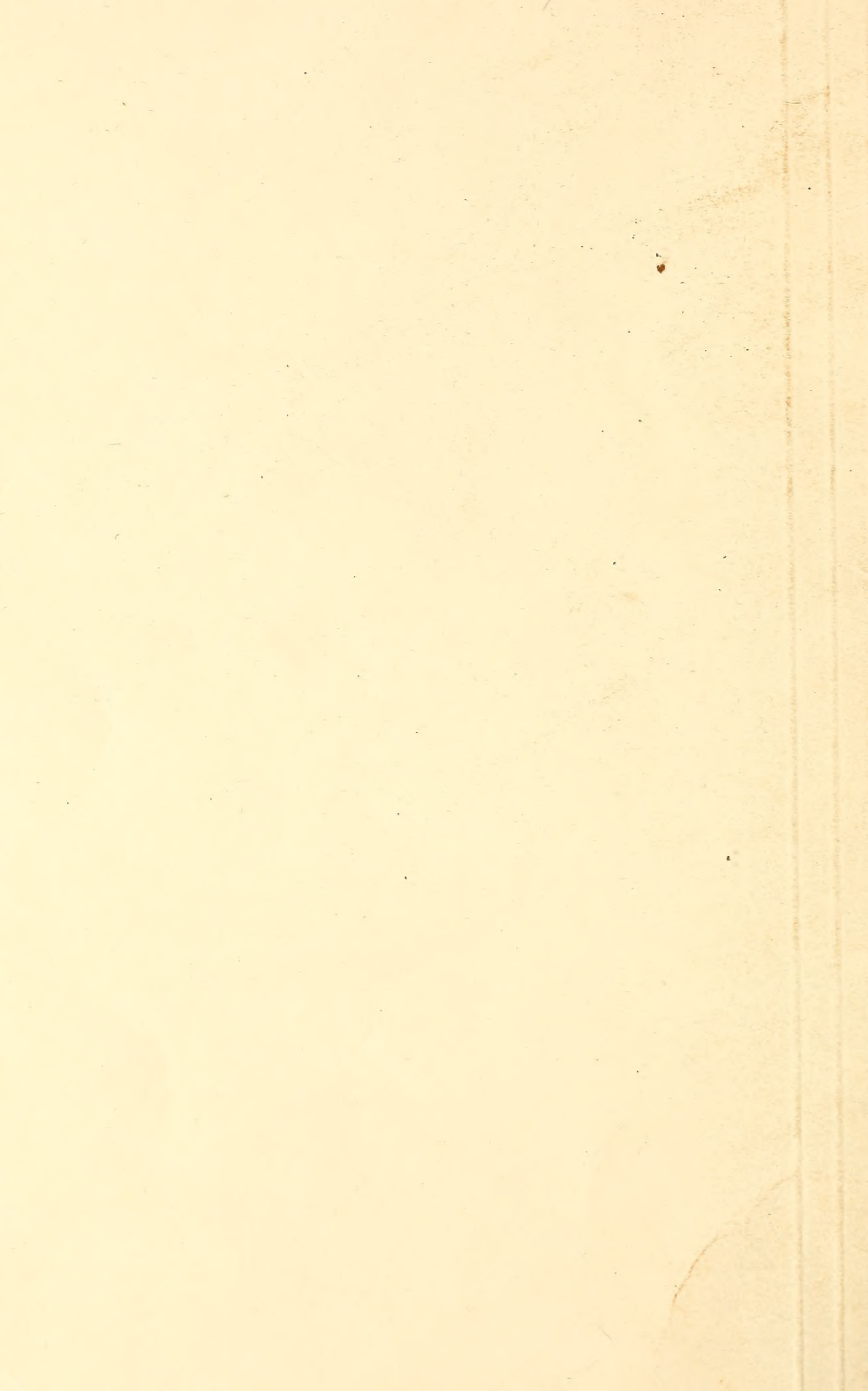
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## United States Department of Agriculture,

## BUREAU OF ENTOMOLOGY,

L. O. HOWARD, Entomologist and Chief of Bureau.

## THE APHIDES AFFECTING THE APPLE.

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## INTRODUCTION.

Four species of aphides, or "plant-lice," commonly infest the apple in the United States, namely, the woolly apple aphis (*Schizoneura lanigera* Hausm.), the European grain aphis (*Siphocoryne avenæ* Fab.), the apple aphis (*Aphis mali* Fab.), and the rosy apple aphis (*Aphis mali-foliæ* Fitch). The first mentioned—the woolly apple aphis—infests the roots of the apple, producing a knotted, distorted growth, and also the limbs and branches, where the colonies are quite conspicuous from the white, flocculent material which the insects secrete. This species has been treated in Circular No. 20, second series, of this office, to which the reader is referred. The other species above mentioned infest the more tender growing shoots and leaves of the apple, and are especially injurious when occurring on young orchard or nursery trees, which are more commonly infested than older trees, making comparatively little annual growth. Water sprouts also are frequently infested, and the shoots of top-worked trees are especially subject to attack.

The presence of these insects is indicated by the curled and distorted condition of the more terminal leaves, and if a plant showing these symptoms be closely examined, small oval or pear-shaped soft-bodied aphides, greenish or pink in color according to species, will be found on the under surface of the leaves, along the tender stem or elsewhere, often practically covering these parts (see figure 1).

Each aphis is provided with a small beak, which is pushed down into the tissues of the leaf or stem and by means of which the sap is sucked up for food. When the insects are abundant, the drain upon the plant is very great, interfering with its proper growth and development, and in extreme cases causing the death of the infested parts.

The leaves and shoots of plants infested by these insects are frequently seen to be covered with a black substance, as if dusted with



soot. This is due to a black fungus which grows on the "honey dew" excreted by the aphides. This may be produced in such quantities as to coat the leaves, and is attractive to various species of ants and wasps frequently to be seen attending the aphides or frequenting plants infested by them. The black fungus noted is not in itself especially injurious, but it usually indicates the presence of aphides, which may be the cause of material injury.

#### APHIDES IN GENERAL.

The insects of the family Aphididæ, or "plant-lice," are especially remarkable on account of their mode of development. This will vary considerably according to the species, but at some time in the life of a species true sexes are produced, usually in the fall, the sexual female depositing eggs after the usual manner of insects. Eggs deposited in the autumn pass the winter in this condition, and their hatching in the spring is more



FIG. 1.—Terminal shoot of apple infested with the apple aphid (*Aphis mali*), showing condition of leaves. (Original.)

or less coincident with the revival of growth of vegetation. From the winter eggs is produced a generation of females, usually wingless, which reproduce agamically—that is, without the intervention of males, many species, as those under consideration, giving birth to living young. The adult aphides of this first generation are termed "stem-mothers." The offspring of the stem-mothers (second gener-



ation) may be winged or wingless, or both forms may occur; they reproduce agamically, some species being oviparous and depositing pseudoova, or eggs which do not require fertilization for development; while others are viviparous and bring forth young alive, the pseudoova developing within the body of the parent. There may be a succession of generations produced agamically, with most species this mode of reproduction continuing until the approach of autumn, when the true sexes appear and deposit eggs; or a species may be more or less biennial, some individuals producing true sexes only every second year. With still other species, the true sexes of which are at present unknown, agamic reproduction possibly continues for a series of years. The same species of aphide may present several forms, as wingless agamic females, winged agamic females, and the true sexual forms; in the last the male may be winged and the female wingless, or both sexes may be wingless. The different generations of a given species may vary more or less, and in some instances this is the case to such an extent that they appear to belong to distinct species. Aphides are enabled to increase with great rapidity by reason of the short time required by their young to reach maturity. Their powers of multiplication are so great that if unchecked the product of a single insect during one season would run up into the billions. Very fortunately, however, there are many drawbacks to their increase, among which are certain weather conditions, parasitic and predaceous insects, and fungous diseases. When one or more of these agencies are in abeyance, aphides may become very numerous and destructive locally or over a considerable range of territory.

#### THE EUROPEAN GRAIN APHIS.

(*Siphocoryne avenæ* Fab.)

The European grain aphis (fig. 2) is the common greenish apple aphis of the United States, and is the species erroneously considered by Fitch as identical with the European *Aphis mali* Fab., by which name until recently it has been very generally known in our literature. Two species, however, have been confused under this name, the present and the following, which fact was recognized by Mr. Th. Pergande, and also by Dr. J. B. Smith. Prof. E. D. Sanderson in 1902 described this insect as new under the name of *Aphis fitchi*, but Pergande has subsequently shown that the insect is identical with the European grain aphis (*Aphis avenæ* Fab.), and considers that the species really belongs to the genus *Siphocoryne* of Passerini. This species is recorded from various widely separated localities, and is probably very generally distributed throughout the United States. Twenty-two plants upon which it has been observed are recorded, comprising eight trees, four weeds or herbs, and ten grains and grasses. Of orchard fruits, apple, pear, quince, and plum are food-plants; and of grains, rye, oats, and



wheat are infested, the last, according to Prof. F. M. Webster, often being quite seriously injured by the aphides in the fall, the young plants being attacked at or just below the ground.

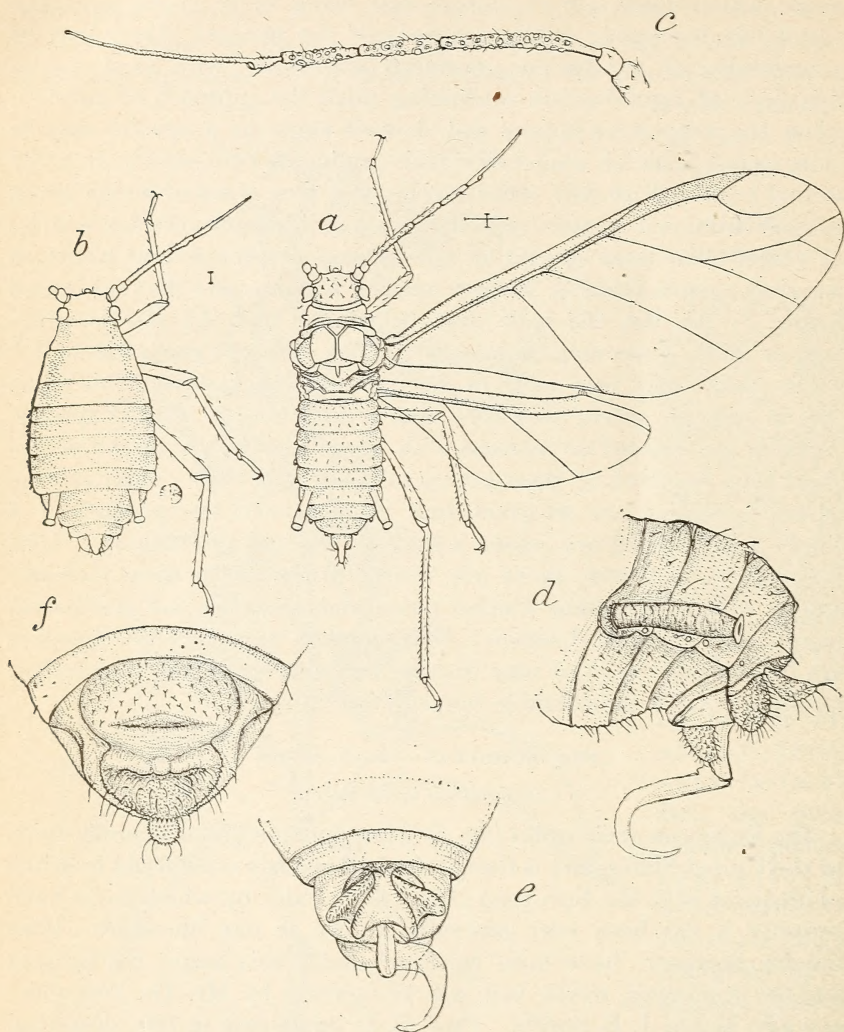


FIG. 2.—The European grain aphid (*Siphocoryne avenæ*), a common aphid on apple; *a*, migratory female; *b*, sexual female; *c*, antenna of migratory female; *d*, side view of end of body of winged male; *e*, under side of end of body of male; *f*, under side of end of body of sexual female. All greatly enlarged (from Pergande).

#### NATURAL HISTORY AND HABITS.

This species has been well treated by Sanderson and Pergande, and has been found to present a very interesting life history. The shiny, jet-black winter eggs are deposited by the females in the fall around the buds of the more terminal shoots, at crotches of limbs, and in cracks



and under scales of the bark. The eggs are quite small, but may be readily detected with the unaided eye. These hatch in spring, about the time the young leaves of the apple are pushing out, and the small, greenish "lice," often occurring in large numbers, at once attack these parts. These insects, when fully grown, are the stem-mothers, and soon begin the production of living young, most of which develop into the winged agamic form which migrates to other trees and to other localities, where new colonies are started, the progeny of the third generation also being winged and wingless. In all, some five generations of aphides develop on the apple, but by early July in the latitude of Washington the trees are free from them, and the aphides have become established on grains and grasses or other host plants. Upon the approach of fall, apple trees are again infested by the return migrants from the grasses and grains, the true females are soon produced, and the winged males come from the grasses upon which they have developed. Winter eggs are deposited during September, October, and early November in the manner indicated.

#### THE APPLE APHIS.

(*Aphis mali* Fab.)

In general appearance the apple aphis (fig. 4), or apple leaf-aphis, is much like the preceding, with which it has been confused. The body is pear-shaped, instead of oval as in *S. avenæ*, the colors of both being yellowish green, greenish, or darker, varying considerably in detailed markings and in the several generations.

*Aphis mali* Fab. (*pomi* De Geer) is of European origin, and has only recently made its appearance in this country, Mr. Pergande having first seen specimens collected in the United States in 1897. However, at the present time it is widely distributed, having been recorded from New Jersey, Delaware, New York, Connecticut, Colorado, Michigan, Alabama, and Georgia.

The records of this Bureau show it to occur in Kentucky, Louisiana, Oregon, Pennsylvania, Nebraska, and Arkansas. In this country the insect appears to infest apple (fig. 1) principally, if not entirely, though in Europe it infests in addition the wild crab (*Pyrus malus*), pear, and white thorn (*Crataegus oxyacantha*).



FIG. 3.—Eggs of the apple aphis (*Aphis mali*) on twig. (Original.)

#### NATURAL HISTORY AND HABITS.

The apple aphis has been studied by Dr. J. B. Smith and Prof. E. D. Sanderson. Winter eggs (fig. 3) are deposited by the sexual females

in the fall, oviposition beginning somewhat earlier than but overlapping with that of the preceding species; they are placed in similar situations, and are not distinguishable from those of *Siphocoryne*

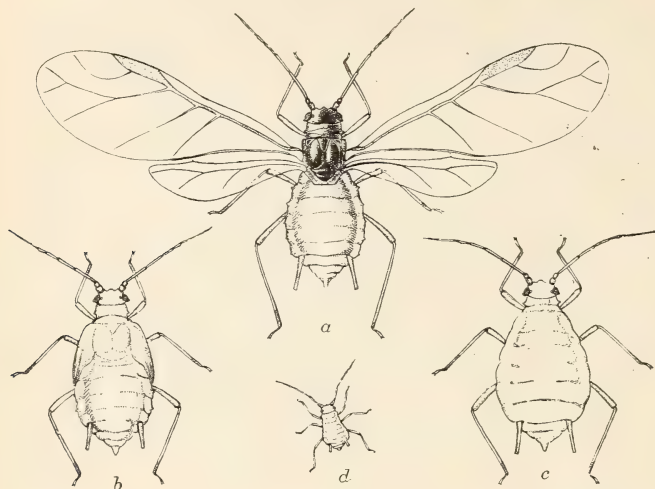


FIG. 4.—Apple aphid (*Aphis mali*): a, winged agamic form; b, pupa; c, wingless agamic form; d, recently born aphid. All greatly enlarged (original).

*avenæ*. They hatch perhaps somewhat later in the spring, and after the foliage is further advanced and, like the species next considered, the aphides developing from them cause a greater curling of the

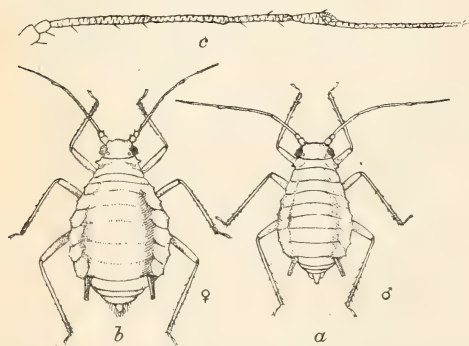


FIG. 5.—Apple aphid (*Aphis mali*): The true sexual forms: a, male; b, female. Greatly enlarged (original).

leaves. The apple leaf-aphis infests the apple throughout the year and for this reason is capable of more injury than the other species herein treated. Upon the hatching of the winter eggs in spring a succession of agamic generations is produced, the earlier ones, except the first, with numerous winged individuals which migrate to other trees and establish new colonies. In New Jersey, as found by Doctor Smith, there may be during the season seven agamic generations followed by the development of the sexual wingless males and females (fig. 5) in the fall.



## THE ROSY APPLE APHIS.

(Aphis malifoliae Fitch.)

The rosy apple aphis (fig. 6), regarded by Pergande as *Aphis malifoliae* Fitch, and determined by Sanderson as *Aphis sorbi* Kaltenbach, is readily distinguished from the preceding by its larger size, rounder body, and usually rosy color, which, however, may vary from salmon to tan or even to slaty gray or black, the body being covered with a whitish pulverulence. This species is very generally distributed in the United States, occurring in such widely separated States as Illinois, Connecticut, New Jersey, Virginia, Washington, California, South Carolina, and West Virginia; it occurs also in Canada. The species is common on apple, but has been taken by Sanderson on pear.

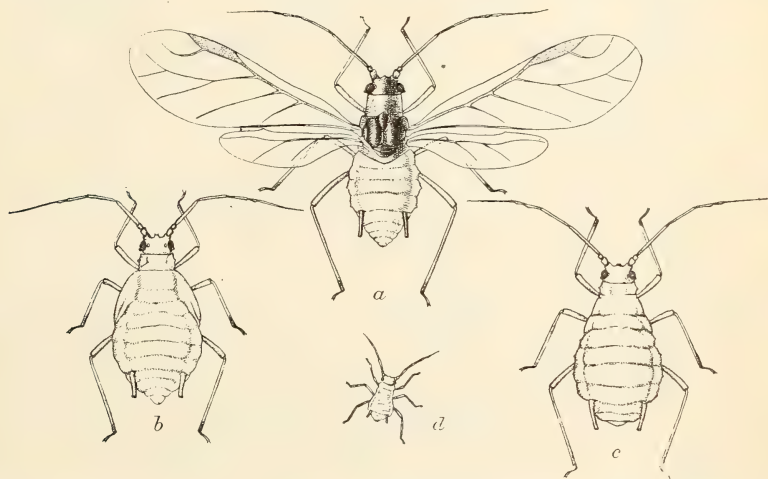


FIG. 6.—Rosy apple aphis (*Aphis malifoliae*): a, winged agamic form; b, pupa; c, wingless agamic form; d, recently born aphid. All greatly enlarged (original).

In Europe the food plants of *Aphis sorbi*, in addition to apple, are *Crataegus oxyacantha*, *Sorbus aucuparia*, *S. domestica*, and *S. torminalis*.

## LIFE HISTORY.

The life history of this species is but imperfectly known. Winter eggs are deposited in the autumn by sexual females, and more often on the trunk and larger limbs than with the other species mentioned. They hatch in spring as the apple leaves are pushing out, and the young aphides infest the young leaves and later the tender shoots and foliage, the latter thus becoming usually badly curled. Three generations from the egg are said to occur on the apple in the spring, many individuals of the second and third generations developing wings and migrating to other trees and to other host plants. After the third generation the apple is deserted by the insects until fall, when the return migrants appear and give rise to the true sexual forms, the females depositing eggs as described.

## NATURAL ENEMIES OF APHIDES.

Aphides are attacked by various species of predaceous and parasitic enemies, and by fungous diseases, and under certain climatic conditions

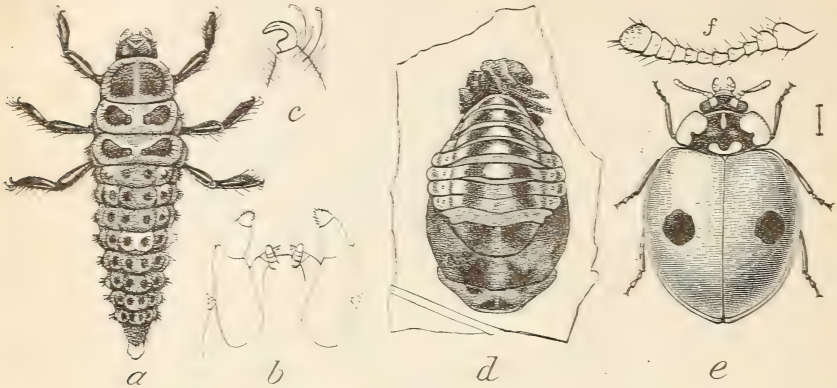


FIG. 7.—Two-spotted ladybird (*Adalia bipunctata*): a, larva; b, mouth parts of same; c, claw of same; d, pupa; e, adult or beetle; f, antenna of same. A common arboreal ladybird. All enlarged (from Marlatt).

these agencies exert a very important influence in their control. Species of ladybirds or Coccinellidæ (fig. 7), aphid lions—the larvæ of Chryso-

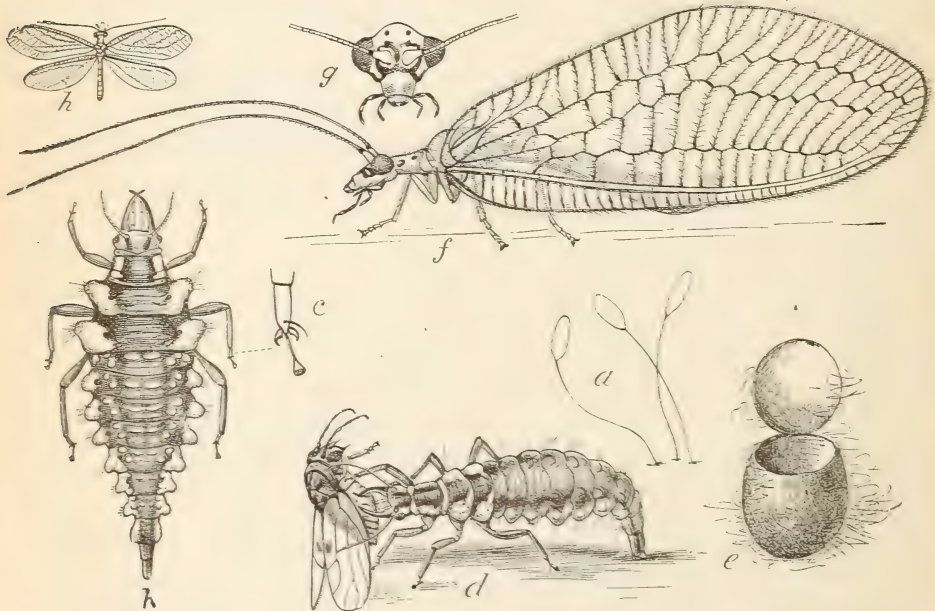


FIG. 8.—The golden-eyed lace-wing fly (*Chrysopa oculata*): a, eggs; b, full-grown larva; c, foot of same; d, larva devouring an insect; e, cocoon; f, adult insect; g, head of same; h, adult, natural size. All enlarged except h (from Marlatt).

pidæ (fig. 8) and Hemerobiidæ—and the larvæ of syrphus flies prey upon the apple aphides, which are destroyed also by small hymenop-



terous parasites. Under certain weather conditions entire colonies may be destroyed by fungous diseases. During periods of rainy weather the insect enemies of aphides are much less active than when the weather is fair. This is particularly true of the minute delicate-winged hymenopterous parasites, to which such weather conditions are largely fatal. With the coming of fair weather, however, these foes of aphides soon multiply, quickly reducing their hosts to much less injurious numbers.

#### METHODS OF CONTROL.

*Pruning.*—As has been stated, the aphides under consideration pass the winter in the egg stage on the apple, the eggs being deposited more or less promiscuously over the more nearly terminal twig. With young trees especially, which are seen to be heavily stocked with the eggs, the latter may be largely removed during the work of pruning, and the prunings should be collected and burned.

The insects in the egg condition are frequently distributed on nursery stock; therefore, if in planting trees this stock be well pruned and the prunings destroyed, the establishment of the aphides in young orchards may be often prevented or delayed.

*Winter spraying for destruction of eggs.*—Several sprays have been at various times more or less used for the destruction of the eggs on the trees; among these are strong lye water, whale-oil soap, and kerosene and crude petroleum—in soap or mechanical emulsions with water or even undiluted. On the whole, very little of practical good seems to have followed these treatments, the eggs being largely resistant to such insecticides as are not so strong as to injure the trees. In the experience of Prof. J. M. Aldrich, however, excellent results have followed the use of lime-sulphur wash, most all of the eggs of the apple aphid having been destroyed by one thorough application in spring shortly before the buds opened. The use of this wash for the eggs of aphides would also control the San Jose scale when present.

*Spring and summer treatments.*—Effective work in controlling these insects may be done in the spring just after they have hatched from eggs and have collected on the expanding foliage. Trees seen to be badly infested at this time should be thoroughly sprayed, taking pains to wet as completely as possible all parts of the leaves, twigs, and branches. However thoroughly the work may be done, some of the “lice” are almost sure to escape destruction, owing to the difficulty of forcing the spray between the unfolding leaves, more or less covered with hairs, where some of the insects will have penetrated. A subsequent treatment in the course of a week should usually be made, especially if the first application is seen to have been unsatisfactory.

After the foliage is well out and more or less distorted from the presence of the aphides, effective spraying is quite difficult, since

many of the insects on the lower surface of the curled leaves will not be hit by the spray. Repeated applications must be made, therefore, as necessary to keep the insects under control. It will often be found practicable to bend over and immerse the terminal shoots of badly infested young trees in a bucket of the spray solution, and this treatment will be very effective.

*Spray mixtures.*—The lime-sulphur wash for the destruction of winter eggs is made according to the usual formula for the wash, namely, lime 20 pounds, sulphur 15 pounds, water to make 50 gallons, and boiled for one hour.

After the trees are in foliage, a more dilute contact insecticide must be employed, as strong tobacco decoction, 15 or 20 per cent kerosene emulsion, 15 per cent crude petroleum emulsion, or whale-oil soap at the rate of 1 pound for each 4 gallons of water. Since aphides secure their food by sucking up sap from within the plant, none of the arsenical poisons would be effective.

Tobacco decoction may be made from tobacco stems and other refuse tobacco by boiling at the rate of 1 pound for each 1 or 2 gallons of water, sufficient water being added to make up for that lost in boiling.

A 20 per cent kerosene or crude petroleum emulsion is made as follows:

Whale-oil or other soap.....	pounds..	2½
Kerosene or crude petroleum.....	gallons..	10
Water to make .....	gallons..	50

The soap is dissolved in 5 gallons of hot water, which is at once poured into the spray-pump barrel. The 10 gallons of kerosene or crude petroleum is next added and the whole thoroughly emulsified by pumping it back through the hose into the barrel for 6 or 8 minutes. After the oil has become thoroughly emulsified, the barrel is filled with water, and the preparation is ready for use. When a less amount of emulsion is desired than the quantity above indicated, it may be reduced as desired by observing the proportions given.

Approved:

JAMES WILSON.

*Secretary of Agriculture.*

WASHINGTON, D. C., December 18, 1906.

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